CLAIMS

What is claimed is:

1. An evaporative cooling device, comprising:

a working fluid comprising a liquid phase and a vapor phase;

one or more channels for containing said liquid phase, wherein each of said one or more channels comprises a first and second end, and wherein said liquid phase wets an interior surface of each of said channels forming thereby one or more menisci separating said liquid and said vapor phases;

a capillary pressure difference across each of said one or more menisci; and

a means for maintaining a gradient in said capillary pressure difference substantially independent of the depth of said liquid phase in said one or more channels, wherein said gradient establishes a flow in said liquid phase in a direction from said first end to said second end.

2. The evaporative cooling device of claim **1**, wherein said means for maintaining a gradient in said capillary pressure difference comprises varying the cross section of said channel in said flow direction.

3. The evaporative cooling device of claim **2**, wherein said means for maintaining a gradient in said capillary pressure difference further comprises reducing a width of each of said one or more channels between said first and second ends.

4. The evaporative cooling device of claim **3**, wherein reducing a width of each of said one or more channels comprises dividing a portion of said one or more channels, wherein said channels decrease in width in said flow direction.

5. The evaporative cooling device of claim **4**, wherein dividing said channels comprises one or more partitions.

6. The evaporative cooling device of claim **3**, wherein reducing a width of each of said one or more channels comprises continuously tapering a cross section of said channels in said flow direction.

7. The evaporative cooling device of claim **3**, wherein said width is reduced by up to about 70% between said first and second ends.

8. The evaporative cooling device of claim **1**, wherein said means for maintaining said gradient comprises an array of post-like features disposed in said one or more channels.

9. The evaporative cooling device of claim **8**, wherein said post-like features comprise a cross-sectional shape selected from the list consisting of circles, ellipses, rectangles or polygons, and a height about equal to a depth of said one or more channels.

10. The evaporative cooling device of claim **9**, wherein each of said post-like features is separated from every other said post-like feature by a minimum separation distance, wherein said minimum separation distance progressively decreases in said flow direction.

11. The evaporative cooling device of claim **10**, wherein said post-like features are uniformly arranged in columns parallel to said flow direction and centered along equidistantly spaced axes.

12. The evaporative cooling device of claim **9**, wherein said post-like features are uniformly disposed in rows perpendicular to said flow direction, and wherein the number of post-like features in each said row increases monotonically in said flow direction.

13. The evaporative cooling device of claim **1**, further comprises a cover plate having one or more openings comprising an interior wall, wherein said cover plate covers said channel, and wherein a meniscus forms at said interior wall within each of said one or more openings.

14. The evaporative cooling device of claim **13**, wherein said openings are triangular or trapezoidal, wherein the openings are tapered in said flow direction, and wherein said working fluid at least partially fills and wets said interior wall.

15. The evaporative cooling device of claim **14**, wherein said triangular or trapezoidal openings are segmented.

16. The evaporative cooling device of claim **13**, wherein said openings comprise a plurality of shapes selected from the list consisting of circles, ellipses, rectangles or polygons.

17. The evaporative cooling device of claim **16**, wherein each of the openings in said flow direction comprises an area smaller than each previous opening.

18. The evaporative cooling device of claim **17**, wherein said openings are uniformly disposed in rows perpendicular to said flow direction, and wherein the number of openings in each row increases monotonically in said flow direction.

19. The evaporative cooling device of claim **17**, wherein said openings are uniformly arranged in columns parallel to said flow direction and centered along equidistantly spaced axes.

20. A heat exchanger comprising the evaporative cooling device of claim **1**, and further comprising means for condensing and recirculating said working fluid.

21. A method for removing heat from a body, comprising the steps of:

providing a working fluid comprising a liquid phase and a vapor phase;

providing a thermally conductive substrate comprising one or more channels for containing said liquid phase, wherein each of said one or more channels comprises a first and a second end, wherein said liquid phase wets an interior surface of each of said channels forming thereby one or more menisci separating said liquid and vapor phases,

bringing said thermally conductive substrate into contact with a heated body, wherein a capillary pressure difference is generated across each of said one or more menisci by heating and evaporation of a portion of said liquid phase, said capillary pressure difference establishing a pressure gradient in said liquid phase; and

maintaining said pressure gradient substantially independent of the depth of said liquid phase in each of said one or more channels, said pressure gradient establishing a flow in said liquid phase in a direction from said first end to said second end.

22. The method of claim **21**, further comprising the steps of condensing and recirculating the working fluid.

23. The method of claim **22**, wherein said step of maintaining said pressure gradient comprises varying the cross section of said channel in said flow direction.

24. The method of claim **23**, wherein said step of maintaining said pressure gradient further comprises reducing a width of each of said one or more channels between said first and second ends.

25. The method of claim **24**, wherein reducing a width of each of said one or more channels comprises dividing a portion of said one or more channels, wherein said channels decrease in width in said flow direction.

26. The method of claim **25**, wherein dividing said channels comprises one or more partitions.

27. The method of claim **24**, wherein reducing a width of each of said one or more channels comprises continuously tapering a cross section of said channels in said flow direction.

28. The method of claim **25**, wherein said width is reduced by up to about 70% between said first and second ends.

29. The method of claim **23**, wherein said step of maintaining said pressure gradient comprises an array of post-like features disposed in said one or more channels.

30. The method of claim **29**, wherein said post-like features comprise a cross-sectional shape selected from the list consisting of circles, ellipses, rectangles or polygons, and a height about equal to a depth of said one or more channels.

31. The method of claim **30**, wherein each of said post-like features is separated from every other said post-like feature by a minimum separation distance, wherein said minimum separation distance progressively decreases in said flow direction.

32. The method of claim **31**, wherein said post-like features are uniformly arranged in columns parallel to said flow direction and centered along equidistantly spaced axes.

33. The method of claim **30**, wherein said post-like features are uniformly disposed in rows perpendicular to said flow direction, and wherein the number of post-like features in each said row increases monotonically in said flow direction.

34. The method of claim **23**, further comprises a cover plate having one or more openings comprising an interior wall, wherein said cover plate covers said channel, and wherein a meniscus forms at said interior wall within each of said one or more openings.

35. The method of claim **34**, wherein said openings are triangular or trapezoidal, wherein the openings are tapered in said flow direction, and wherein said working fluid at least partially fills and wets said interior wall.

36. The method of claim **35**, wherein said triangular or trapezoidal openings are segmented.

37. The method of claim **34**, wherein said openings comprise a plurality of shapes selected from the list consisting of circles, ellipses, rectangles or polygons.

38. The method of claim **37**, wherein each of the openings in said flow direction comprises an area smaller than each previous opening.

39. The method of claim **38**, wherein said openings are uniformly disposed in rows perpendicular to said flow direction, and wherein the number of openings in each row increases monotonically in said first direction.

40. The method of claim **38**, wherein said openings are uniformly arranged in columns parallel to said flow direction and centered along equidistantly spaced axes.